Metropolitan Toronto Area Transportation Energy Study Phase II

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summary report

THE MUNICIPALITY OF METROPOLITAN TORONTO
Toronto Transit Commission
Energy Ontario

march 1984

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March 26, 1984

TO: THE METROPOLITAN TORONTO TECHNICAL TRANSPORTATION PLANNING COMMITTEE

RE: PHASE II - METROPOLITAN TORONTO AREA TRANSPORTATION ENERGY STUDY.

At its meeting of June 23, 1981, the Council of Metropolitan Toronto, in approving Clause No. 1 of Report No. 10 of the Economic Development and Planning Committee, granted authority to proceed with Phase II of the Metropolitan Toronto Area Transportation Energy Study. This Phase of the study was recently completed, and on behalf of the Steering Committee I am pleased to submit this report which summarizes our analyses and findings in accordance with the objectives defined in the study Terms of Reference. This report is supplemented by three Technical Background reports which detail the technical analysis for each of the three study parts:

1. Short Term Transportation Energy Conservation Measures;
2. Development of a Contingency Plan; and
3. Land Use/Transportation Energy Relationships.

Based on the findings of the first part of the study, twelve high energy-conserving measures have been identified as potential candidates for implementation in Metropolitan Toronto in the 1984-1987 period. These proposals are in addition to those energy conservation measures which were adopted by the Council of Metropolitan Toronto in June, 1983, and which are presently being implemented by the Metropolitan Roads and Traffic Department. In the event of a fuel shortage, a Metropolitan transportation contingency plan would be required; the second part of the study has developed a strategy and framework which define the key elements of such a plan. In the third part of the study, a methodology was developed for evaluating the relative transportation energy consumption of residential and employment areas within Metropolitan Toronto, and a review of the Metropolitan Official Plan was undertaken from an energy perspective which identified areas for further consideration in the upcoming comprehensive review of the Plan.

In concluding the Metropolitan Area Transportation Energy Study, I wish to acknowledge the assistance of the study participants and the contribution from the Area Municipalities in the early data collection process. The successful completion of this study is a prime example of significant inter-agency effort and cooperation.

A. R. Gordon
Chairman - Steering Committee
Metropolitan Toronto Area
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1. INTRODUCTION

Energy conservation, particularly in the use of crude oil, is an important aspect of the effort to achieve the goal of self sufficiency in Canada. Though the nation produces more energy than is consumed, it is not self sufficient in oil and must import a significant portion of its requirements. Reductions in the amount of crude oil used will therefore lower these import requirements, improving our balance of trade and reducing our vulnerability to petroleum supply interruptions caused by international events.

Crude oil is the major source of primary energy in Canada and Ontario, supplying over 40% of the basic energy requirements in each. The major use of crude oil is in transportation fuels. Consequently, efforts to conserve crude oil are largely directed at the transportation sector.

Within Ontario, the Ministry of Transportation and Communications (M.T.C.) and the Ministry of Energy have initiated the Transportation Energy Management Program (TEMP) directed at reducing the amount of energy consumed in the transportation sector in the Province. In recognition of this objective and of the need to conserve energy for economic reasons, the Metropolitan Toronto Area Transportation Energy Study (M.T.A.T.E.S.) was initiated in 1979 by the Municipality of Metropolitan Toronto (Metro) and supported by the Province through M.T.C.

The M.T.A.T.E.S. has been undertaken in two phases. Phase I, which was completed in December 1980, examined energy intensities by transportation modes and type of land use and the transportation implications of future energy scenarios. Phase II involved the development of procedures and/or measures that could be implemented by Metro to conserve energy

- immediately through transportation system operational modifications;
- in the long term through changes in land use pattern and densities; and
- during a fuel shortage.

M.T.A.T.E.S. II was conducted under the direction of a Steering Committee reporting to the Technical Transportation Planning Committee. In addition to support staff from the participating agencies, the study team included two coordinators from M.M. Dillon Limited, responsible for traffic and transit operational matters and for land use and contingency planning.

This Summary Report is one of a series of four documents produced during the study:

Summary Report
The purpose of this Summary Report is to summarize the objectives, approach and key findings of the Study;

Short Term Transportation Energy Conservation Measures-Background Report #1
The purpose of this report is to summarize energy conservation measures suitable for immediate implementation within Metro. Those with the greatest potential for fuel savings were identified for implementation and monitoring during 1983;

Energy Conservation through Transportation/Land Use Planning-Background Report #2
This report presents an analysis of measures to reduce transportation energy consumption through land use pattern and density changes and the location of new transportation facilities;

A Contingency Plan Strategy for a Fuel Shortage Background-Report #3
In this report, methods for maintaining reasonable levels of mobility during a fuel shortage were identified and a coordinated strategy prepared. The strategy

also presents specific tasks which should be undertaken by the various agencies with transportation responsibilities within Metro to complete their detailed plans for a fuel shortage.

This Summary Report is organized into four chapters; an introduction followed by chapters on each of the above areas of analysis.

2. SHORT TERM TRANSPORTATION ENERGY CONSERVATION MEASURES

2.1 Purpose

The purpose of this component of Phase II of M.T.A.T.E.S., as outlined in the Terms of Reference for the study, called for the achievement of three objectives. These objectives are:

i. Develop a complementary package of low-cost, short-term transportation conservation measures;
ii. Develop an implementation program for these measures, and
iii. Implement and monitor the program to determine energy savings.

Short term was defined to be the five year period from 1983 to 1987, inclusive. For the purposes of monitoring, only those measures which could be implemented within the time frame of Phase II of M.T.A.T.E.S. were actually monitored; these being those measures whose implementation could be initiated in 1983. Consistent with this approach, two implementation programs were developed for the 1983-87 period with some measures to be monitored starting in 1983 and the others in 1984.

Low cost was intended to exclude any measures which involve substantial capital investments such as the construction of new road facilities, the purchase of fleets of vehicles, major land acquisition etc.

2.2 Approach

The approach followed to achieve the above objectives, involved undertaking four basic steps:

The first step was the preparation of a long list of measures representing all the possible short term, low-cost conservation measures which could be considered for Metro. A long list of some 90 measures was produced from a review of the literature on transportation energy conservation. Because of the large percentage of

total energy consumption attributable to road facilities and the traffic on such facilities, a large number of the measures are directed at modifications to these facilities to improve traffic flow.

The second step involved a prescreening process wherein the long list of measures was subjected to a preliminary evaluation in order to:

- eliminate measures which are not applicable to Metro; and,
- highlight those measures which could be implemented immediately in Metro in 1983.

The set of evaluation criteria which were applied in this pre-screening process are:

A. Short Lead Time
   - A.1 0-3 months (applicable to measures for immediate implementation in 1983)
   - A.2 3-12 months (measures for 1984 implementation)
   - A.3 12-36 months (measures for 1985-87 implementation)

B. Minimal Institutional Obstacles
   - B.1 Administrative
   - B.2 Legal
   - B.3 Funding

C. High Energy Reduction

D. Safety Considerations.

The third step in the analysis of energy conservation measures, involved a detailed assessment of those measures which were deemed to be candidates for immediate implementation in 1983 and a more general assessment of those measures deemed as candidates for implementation in 1984-87.

In the detailed assessment of candidate measures for immediate implementation, an analysis was undertaken for each measure to identify: the energy impact on a site-specific basis and extrapolate to an areawide scale throughout Metro; the associated implementation

costs; and the implementation process including jurisdictional responsibility, affected programs, and approximate timing. From this information, a recommended implementation strategy commencing in 1983 was developed. In the general assessment, similar analyses were undertaken, except that implementation obstacles were not considered explicitly as an evaluation criterion.

The fourth step involved the monitoring of the energy savings resulting from energy conservation measures which were actually implemented in 1983. This involved field observations of the levels of vehicle stops and delays both before and after implementation of the recommended measures. The levels of stops and delays were then translated into estimates of energy consumption.

2.3 Findings

2.3.1 Measures Implemented in 1983

Among the long list of measures assessed in the prescreening process, eighteen measures were identified as potential candidates for implementation in Metro in 1983. A detailed assessment of these measures resulted in the recommendation to proceed with immediate implementation of three measures and the monitoring of the energy savings resulting therefrom.

The three measures recommended to be implemented and monitored in 1983 are:

1. computer optimized signal timing;
2. semi-actuated signal control; and
3. variable signal phasing throughout the day.

A report was prepared and submitted to the Metropolitan Transportation Committee on May 17, 1983 outlining the rationale for the selection of these measures and presenting an areawide 5 year implementation program for the measures. This report entitled

"Proposed Conservation Measures for 1983" was adopted by Metropolitan Council in June 1983 and is attached as Appendix A.

The Metro Toronto Roads and Traffic Department has begun the implementation of the three recommended measures. Implementation of the semi-actuated signal control and variable signal phasing throughout the day measures has proceeded quickly. An assessment of the actual energy conservation performance of these two measures was to be made.

A monitoring program was developed and applied to assess the actual energy savings generated by the above two measures versus those originally anticipated. To this end, representative sites were selected and measurements of the energy consumption both before and after introduction of the measures were made. These estimates and measurements were then extrapolated to areawide energy savings on the basis of the number of applicable sites throughout Metro.

The results of this monitoring program are outlined below:

Measure	Monitoring Site	No.of Applicable Sites Areawide	Percentage Areawide Energy Savings Anticipated	Actual
Semi-actuated (SA) signal control	Kingston Rd.& Chine Drive			
. conversion of fixed time to enhanced SA control		125	0.65%	1.06%
. conversion of conventional SA to enhanced SA control		300	1.34%	1.62%
Variable signal phasing throughout the day	Sheppard Ave. & Shaughnessy Blvd.	335	0.17%	0.07%
			2.16%	2.75%

Both of the above measures were found to produce energy savings of the same order of magnitude as those originally anticipated before their actual implementation and monitoring.

2.3.2 Measures Proposed for Implementation in 1984-87

The assessments undertaken in steps two and three of the study approach resulted in the identification of 61 measures as potential candidates for implementation in 1984-87. These 61 measures are in addition to the three measures whose implementation began in 1983 and which will continue to the end of 1987.

Among the 61 candidate measures for implementation in 1984-87, twelve measures were found to be significant energy conserving measures (savings of at least 0.01% of total areawide consumption) and as well as being cost-effective (having a benefit/cost ratio of greater than 2.0 with benefit measured in terms of dollars of fuel savings achieved and cost being the annualized cost of implementation).

These twelve measures and the categories that they fall into are listed in Table 2.1 and are described in the following sections. These measures are being proposed from an energy perspective only. It is recognized that other considerations must be taken into account prior to the approval of an implementation schedule for such measures. For example, the operating agencies may evaluate the proposed measures taking account of operational concerns as well as total user benefits, not only energy savings.

TABLE 2.1

MEASURES PROPOSED FOR IMPLEMENTATION IN 1984-87

CATEGORY	MEASURE
Removal of Unnecessary Devices	. Replace unwarranted all-way stops with 2-way or 1-way stop control. . Where warranted replace all-way stops with semi-actuated traffic signals.
Reduce Speed Limits	. Reduce the posted speed limits by 10 km/h on all freeways and expressways in Metro.
Ridesharing Incentives	. Provide carpool matching assistance to employers.
Additional Capacity	. Implement 1-way street plan in downtown Toronto.
Turn Conflict Treatment	. Prohibit left turns at signalized intersections without left turn lanes. . Reduce conflicts between pedestrian crossings and vehicular turns by split green phasing.
On Street Parking Restrictions	. Remove curb parking in peak periods in the off-peak direction of travel.
Reduce Transit Travel Time	. Provide express bus service.
Variable Work Hours	. Encourage employers to implement and utilize: - Staggered work hours, and/or - Flexible work hours, and/or - Compressed work weeks.

2.3.2.1 Removal of Unnecessary Devices

Two measures comprise the category of removal of unnecessary devices:

1. replace unwarranted all-way stops with 2-way or 1-way stop control, and
2. where warranted, replace all-way stops with semi-actuated traffic signal control.

There are some 1,200 intersections in Metro under all-way stop control. Each of the Area Municipalities in Metro have adopted sets of warrants based upon traffic engineering principles and experience which are to be applied wherever all-way stop control is being considered for a particular intersection. These warrants constitute conditions of traffic operations which should prevail before all-way stop control is said to be warranted.

Even though such warrants exist for all-way stops and other types of traffic control devices, and are applied by the traffic departments prior to the installation of new traffic control devices, frequently all-way stops are implemented at intersections based on decisions not related to traffic engineering principles.

Estimates of the proportion of all-way stops which do not meet municipal traffic engineering warrants, but which have been installed at intersections within Metro Toronto range from 50 to 75%. Most of the unwarranted all-way stops in Metro would be replaced by 2-way stop control or 1-way stop control (e.g. at the intersection of two 1-way street pairs or "tee" intersections) according to a strict interpretation of the traffic control warrants. In some instances, where all-way stop control has been installed as an interim measure prior to the implementation of signal control, semi-actuated traffic control could be implemented immediately. Either case is preferable from both an energy conservation perspective and traffic efficiency and safety perspective to that of all-way stop control.

As part of the implementation procedure associated with the removal of unnecessary traffic control devices, it would be necessary for each of the Area Municipal traffic departments to first identify those intersections under all-way stop control. An assessment would then be made to identify whether this type of control is unwarranted or if the intersection is a candidate for semi-actuated signal control. Such an

assessment would involve collecting up-to-date traffic counts and accident records and reapplying the traffic control warrants wherever such information was found to be out-of-date by a year or more. The next step would be to establish the preferred form of replacement control; these being either 2-way/1-way stop control or semi-actuated signal control. Finally, approval would have to be obtained from the local political body for such changes and appropriate modifications made to the affected municipal traffic by-law.

2.3.2.2 Reduce Speed Limits

The measure proposed involves reducing the posted speed limits by 10 km/h on approximately 33 km of freeway under Metro's jurisdiction and approximately 90 km of freeway under M.T.C. jurisdiction within Metro. The resulting posted speed limits would be 80 km/h on Metro freeways and 90 km/h on M.T.C. freeways.

This measure may be implemented by both the M.T.C. and by Metro by modification of the appropriate Order-in-Council and traffic by-laws governing the speed limits along freeway sections. All existing speed limit signing would have to be changed to reflect the new speeds.

In order to make this measure effective and ensure safe operations, it would be necessary to implement increased police surveillance of motorists to insure compliance with the new speed limits. General acceptance of this measure by the public will depend, in the long run, on perceived direct benefits and/or the need to conserve energy.

2.3.2.3 Ridesharing Incentives

The measure proposed involves setting up and operating a rideshare matching service for major employers throughout Metro. The service would require that a computer matching program be developed which

could handle a large data base of prospective carpoolers from a variety of companies. The service would be operated by a government agency which would provide staff, computerized facilities and administrative functions.

The actions of this agency would involve initiating contacts with large employers to encourage participation among employees, the provision of carpool information booklets and employee data requirement forms, data processing of the records received from applicants requesting carpool matches, the issuing of reports to employers identifying the numbers and names of prospective carpool match-ups, and the maintenance of an on-going data base of current carpool participants and new applicants.

The large employers who would be assisted by the carpool matching agency would be requested to perform all internal contacts with their employees. The employers would also be required to prepare records of the applicants for the carpool matching service in a format suitable for input to the computer matching program operated by the governmental agency.

Carpool matching assistance would be provided in the above manner initially to all firms within Metro having 300 or more employees. It is estimated that there are approximately 338 firms in Metro which fall into this category with a total employment of about 251,000 employees. Employee participation rates of 5-8% are anticipated based upon the experience of the Government of Ontario carpool demonstration project for Government employees in the Toronto area.

Research and development for rideshare programs is an on-going program by the M.T.C. in conjunction with the Ministry of Energy.

2.3.2.4 Additional Capacity

The provision of additional capacity involves the implementation of additional one-way street pairs in downtown Toronto. The downtown area of Toronto has been proposed since it constitutes the only area within Metro which has closely spaced major roads in a grid pattern. These elements are essential for the effective operation of a one-way street system.

For the purposes of assessing the benefits and costs of such a measure, an extensive system of one-way streets within the downtown area was assumed. The implementation of this measure would require the cooperation and approval of Metropolitan Toronto, the City of Toronto and the Toronto Transit Commission. Approval of the Toronto Transit Commission would be essential since the implementation of a system of one-way streets in the downtown area would affect the extensive surface transit network, in particular the streetcar routes. These routes might have to operate on exclusive transit contra-flow lanes. Detailed operational studies would have to proceed prior to determining the necessary modifications to the transit and road systems.

The major benefit to be derived from the proposed one-way street plan would be the elimination of left turning movements against opposing traffic on the same street and significantly improved signal progression. These improvements to traffic operation would, in turn, lead to reduced levels of vehicle stops and delays and thus reduced energy consumption.

2.3.2.5 Turn Conflict Treatment

Two measures comprise the category of turn conflict treatment:

1. prohibit left turns at an intersection without a left turn lane during peak periods, and
2. reduce conflicts between pedestrian crossings and vehicular turns by split green phasing.

The first measure would reduce fuel consumption by eliminating unnecessary stops to through automobiles and transit vehicles, due to other traffic wishing to make a left turn from a through traffic lane.

The second measure involves separating pedestrian crossings from vehicle turning movements on the same green phase at intersections with continuous pedestrian crossing traffic. This type of measure has been implemented by Metro Roads and Traffic at selected intersections with advanced green operation, but could be applied at other intersections where significant pedestrian activity exists. This measure involves permitting pedestrian crossings to occur during only part of the green phase. As vehicles must yield the right-of-way to pedestrians, this part of the green phase would essentially prohibit vehicle turns. Conversely, for the latter part of the green phase, pedestrians would be prohibited from crossing, thus facilitating vehicle turns. The provision of an exclusive green interval to vehicles would increase the operational efficiency of the intersection for vehicles and thereby decrease energy consumption. It would also increase the level of safety for both pedestrians and vehicles since it would eliminate the simultaneous occurrence of conflicting movements between pedestrians and vehicles.

Metro Roads and Traffic would be responsible for the implementation of these two measures. The first measure involves the erection of turn prohibition signs and the modification of the traffic by-law governing the intersections so affected. The effect of local neighbourhood traffic control plans would have to be considered in conjunction with implementation of this measure. The second measure would involve signal timing changes to the pedestrian signal heads and wherever pedestrian signal heads do not exist (assumed to be for 50% of the prospective locations), the installation of pedestrian signal heads.

Prior to implementing these two measures, analysis would have to be undertaken by Metro Roads and Traffic staff to identify the precise locations and numbers of applications for each of these two measures.

2.3.2.6 On-Street Parking Restrictions

The measure proposed involves the prohibition of curb parking during the a.m. and p.m. periods of peak traffic levels in the off peak direction of travel. All roads in Metro currently have parking restrictions imposed for these periods for the peak direction of travel and the majority of roads also have similar on-street parking in the off peak direction of travel.

Approximately 43 km of Metro roads have been identified as locations for the application of this measure. Any changes to the signing on these roads is the responsibility of the Metro Roads and Traffic Department. All such restrictions concerning on-street parking on these roadways would require appropriate changes in the traffic by-laws for Metro Toronto.

2.3.2.7 Reduce Transit Travel Time

The measure proposed consists of providing express bus service. Express bus service eliminates local bus stops between major points of origin and destination along a route or corridor and thereby increases average bus speeds. The purpose of this service is primarily to attract additional riders from the automobile mode by making transit travel times and comfort comparable to that of the auto.

Twenty-seven routes have been identified as potential candidates for this measure. Responsibility for the implementation of these routes would be subject to review by the Toronto Transit Commission through their annual service standards review. The provision of express bus service is an on-going program of the Toronto Transit Commission.

2.3.2.8 Variable Work Hours

The purpose of variable work hour programs is to redistribute tripmaking from peak periods to other times of the day. In this way, the transit and road systems which currently operate near their capacities during peak periods may be operated more efficiently. The impact of this measure would be to improve operating characteristics such as travel speed and schedule adherence for existing levels of demand and/or to provide more capacity to carry additional tripmakers during the peak periods. Some extension of on-street parking prohibitions into off-peak periods may be required to supplement this measure.

There are three types of variable work hours programs:

1. Staggered Hours

   This program provides for the implementation of changes to fixed schedules of starting and finishing times for all employees or subsets of employees for an employment location.

2. Flexible Hours

   This program permits employees to adjust to their own working hours with start and quitting times varying if necessary and their presence required only during a core period (e.g. 9.30 a.m. to 3.30 p.m.) subject to their working a full complement of hours for a one-week or two-week period.

3. Compressed Work Week

   This program involves conversion of a regular work week into a compressed week of 4 or 4½ days. This usually involves extending the hours worked per day.

All of the above programs are intended to change the times at which workers arrive at and leave from work. Properly designed and

coordinated programs across a large proportion of the work force within a designated geographic area would have the effect of reducing the peaking characteristics of travel during the morning and afternoon peak periods.

Since the T.T.C. have already initiated actions to promote these programs, responsibility for continued promotion of these programs would best lie with the T.T.C. The T.T.C. have also proposed a follow-up survey of firms which were initially contacted during the March 1982 promotional campaign, conducted by the T.T.C., to encourage Metro employers and employees to adopt variable work hours.

2.3.3 Proposed Implementation Schedule for 1984-87

The above measures are proposed to be implemented over the period 1984-87. These measures are in addition to those already recommended and approved for implementation over the period 1983-87.

The implementation schedule for these measures appears in Table 2.2. This is a preliminary schedule to be used as a strategic framework which would be presented to each of the agencies affected in order to solicit their official responses regarding the impact of these measures on their operations. Details regarding the exact number of applications, precise locations, and accurate costs of implementation for each measure would have to be obtained from such agencies.

TABLE 2.2

PRELIMINARY SCHEDULE OF APPLICATIONS AND COSTS(1)
FOR MEASURES PROPOSED FOR IMPLEMENTATION IN 1984-87

Rank Of Category	Category And Measure	Applications and Additional Costs Per Year								Costs		Fuel Savings(2)	
		1984		1985		1986		1987					
		Appl.	Cost	Appl.	Cost	Appl.	Cost	Appl.	Cost	Capital Start-Up	Operating (Annual)	% Reduction of Total	Litres Per Year
1.	Removal of Unnecessary Devices - Replace unwarranted all-way stops with 2-way or 1-way stop control - Where appropriate replace all-way stops with traffic signal control	0 0	$34,500(3) to 43,500(3) $34,500(3) to 43,500(3)	180 to 270 20 to 30	$ 81,000 to 121,500 $ 800,000 to 1,200,000	180 to 270 20 to 30	$ 81,000 to 121,500 $ 800,000 to 1,200,000	180 to 270 20 to 30	$ 81,000 to 121,500 $ 800,000 to 1,200,000	$ 277,500 to 408,000 $ 2,434,500 to 3,643,500	$ 0 $ 0	(4) 0.77% to 1.16% (4) 0.08% to 0.12%	21,600,000 to 32,400,000 2,190,000 to 3,290,000
2.	Reduce Speed Limits - Reduce posted speed limit by 10 km/h on all freeways		$100,000(3)	123km	$ 47,850	0	$ 0	0	$ 0	$ 147,850	$ 0	(4) 0.36%	13,700,000
3.	Ridesharing Incentives - Provide carpool matching assistance to employers	0	$318,000(5)	3,125 to 5,000 carpools per day	$ 159,000(5) +234,000(6)	6,250 to 10,000 carpools per day	$468,000(6)	6,250 to 10,000 carpools per day	$468,000(6)	$ 477,000	$468,000	(6) 0.30% to 0.48%	8,340,000 to 13,340,000
4.	Additional Capacity - Implement 1-way street plan in downtown Toronto	0	$ 167,500	0	$ 783,000	0	$783,000	3 road pairs	$ 783,000	$ 2,516,500	0	(4) 0.17%	4,740,000
5.	Turn Conflict Treatment - Prohibit left turns at intersections without left turn lanes - Reduce conflicts between pedestrian and vehicular movements by split green phasing	0 0	$ 5,000(3) $ 5,000(3)	36 30	$ 23,750 $ 112,500	36 30	$ 23,750 $ 112,500	0 0	$ 0 $ 0	$ 52,500 $ 230,000	$ 0 $ 0	(4) 0.06% (4) 0.03%	1,800,000 875,000
6.	On-Street Parking Restrictions - Remove curb parking in peak periods in the off-peak direction of travel	43km	$ 5,000(3) +43,000	0	$ 0	0	$ 0	0	$ 0	$ 48,000	$ 0	(4) 0.03%	1,260,000
7.	Reduce Transit Travel Time - Provide express bus service	0	$25,000(3)	9 routes	$ 67,500	9 routes	$ 67,500	9 routes	$ 67,500	$ 25,000	$202,500	0.04%	1,090,000
8.	Variable Work Hours Encourage employers to implement and utilize: - staggered work hours and/or - flexible work hours and/or - compressed work weeks.	2,675 to 5,350 downtown employees	$ 25,000	0	$ 0	0	$ 0	0	$ 0	$ 0	$ 25,000	0.01% to 0.02%	300,000 to 600,000
	TOTALS		$ 810,330 to 828,350		$ 2,260,750 to 2,701,250		$2,335,750 to 2,776,250		$2,199,500 to 2,640,000	$ 6,208,850 to 7,348,350	$695,500	2.87% to 2.69%	57,895,000 to 75,095,000

(1) All costs are specified in 1983 dollars
(2) Assuming measure has been fully implemented throughout Metro
(3) Planning and/or design costs which are additional to unit costs
(4) Assumed as part of regular maintenance budgets for road and traffic control systems
(5) Computer program development costs
(6) Assuming carpool matching service annual operating costs of $468,000.

3. ENERGY CONSERVATION THROUGH TRANSPORTATION/LAND USE PLANNING

3.1 Purpose

The Metropolitan Toronto Area Transportation Energy Study Phase I and II have examined short and long term measures to reduce fuel consumption for travel within Metropolitan Toronto. The emphasis of these studies has been on direct methods for reducing fuel usage, such as traffic signal timing modifications and intersection improvements. Analysis of land use patterns and densities as they influence travel behaviour, was also undertaken. In the long term, such land use factors can significantly influence the amount of vehicular travel undertaken and the proportion of that travel taken by transit.

This part of M.T.A.T.E.S. II provides:-

- a review of the need for policy changes to Metroplan to further enhance opportunities for saving fuel in urban transportation;
- a method for rating the expected transportation energy consumption for new residential, office or industrial projects;
- an examination of opportunities to influence land use patterns in relation to transit.

3.2 Approach

The approach to the study included a qualitative assessment of the compatibility of Metroplan with general principles of energy conservation and a quantitative assessment of transportation/land use relationships in Metro derived from available data.

The qualitative assessment was based on an extensive literature review on energy conservation through metropolitan scale planning strategies. The general principles derived from this review were used to assess the appropriateness of the direction in which Metroplan guides land use and transportation system development within Metropolitan Toronto.

The quantitative analysis included the derivation of a method whereby the energy efficiency of various land uses and locations within Metro could be determined.

3.3 Findings

3.3.1 General Principles of Energy Conservation

The following principles of land use and transportation planning at the metropolitan scale are considered appropriate in Metropolitan Toronto:

- encourage the development of the urban area in a compact and contiguous form - development should proceed sequentially with no major blocks of land left vacant. Land use should be intensified through infilling and redevelopment;
- achieve high overall density in major land uses - residential, commercial, industrial - to minimize the urban land area and therefore travel requirements;
- develop a system of high density nodes and corridors which will encourage transit usage and reduce trip frequency;
- arrange land uses in an integrated pattern of activity, whereby diverse but compatible uses are in close proximity, a balance of employment opportunities and labour force are present within each major area of the community, residential and employment areas contain retail and community uses and redevelopment projects are of a mixed-use nature.

The opportunities for achieving major changes in the land use pattern and form of Metro are limited by the fact that most land is already developed. The continued redevelopment and intensification within the Corporation's boundaries does, however, provide considerable opportunity for pursuing long term energy conservation objectives. The current planning approaches of Metro and the Area Municipalities are generally consistent with the principles of energy conservation through land use. Table 3.1 presents a summary of the Metropolitan Toronto land use/transportation planning approach in terms of these principles.

TABLE 3.1

COMPATIBILITY OF METROPOLITAN TORONTO PLANNING DIRECTION WITH TRANSPORTATION ENERGY CONSERVATION PRINCIPLES

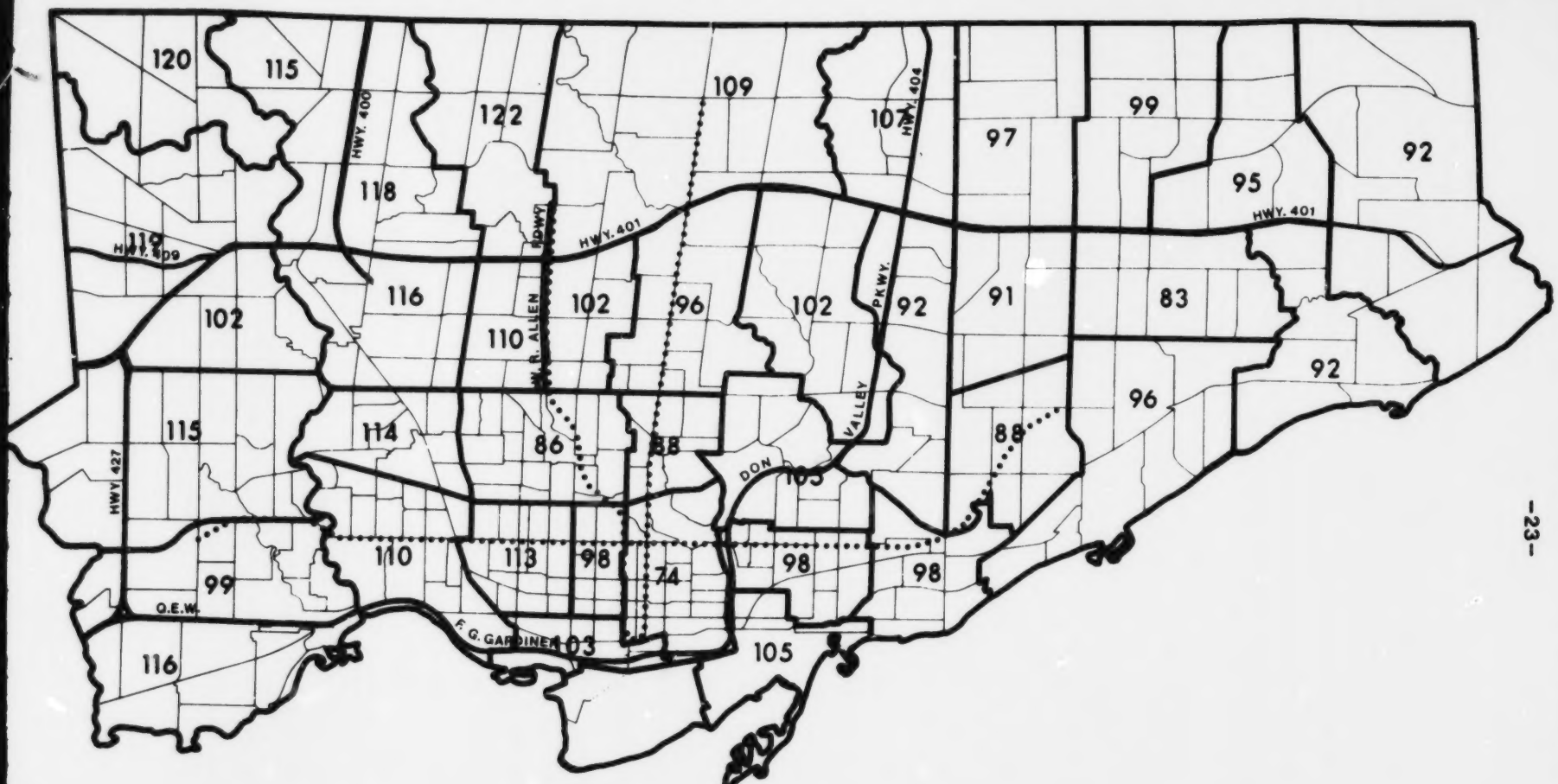
ENERGY CONSERVATION PLANNING PRINCIPLE	METRO TORONTO PLANNING DIRECTION
Urban Form and Structure	
- Compact and Contiguous Form	- no large blocks of land by-passed - encouragement for redevelopment and intensification - emphasis on transit
- High Overall Density	- completion of development within vacant lands in Scarborough and northern Etobicoke - high density redevelopment encouraged at specific locations - continued growth in employment
- Nodes and Corridors	- major development strategy within Metro - transit routes planned to support high density sub-centres - local policies encourage higher densities at nodes and along main travel corridors
Land Use	
- Integrated Land Use Pattern	- trend to more mixed uses at Metro scale - housing in central areas and waterfront - greater employment opportunities, amount and type, in suburbs - development of major retail facilities in suburbs

3.3.2 Transportation/Land Use Relationships Within Metro

The analysis of data on transportation and land use relationships within Metro resulted in the identification of several factors which can be used to guide development in Metro in a more energy efficient manner:

- parking policies which limit the availability of vehicular parking space should be used and are an effective technique for influencing greater transit usage where rapid transit is available;
- the availability of rapid transit can induce a transit modal split as high as 75-80% of all employee travel to jobs within walking distance of subway stations;
- residents located close to a subway station show a high tendency to transit usage (50-60% of all work/school trips). Transit ridership from a specific site will be approximately 8.5 times as high for apartments compared to single family units in a similar location;
- where a mix of land uses are proposed for areas surrounding subway stations, high density offices should be closest to the station with high density residential surrounding the employment activities. High density employment should be located within a short walking distance of a station whereas apartments can be located farther away and maintain high levels of transit usage;
- to achieve a greater balance of labour force and employment, residential development should be guided to the central and mid-town areas of the City of Toronto, to the Don Valley/Thorncillfe area, to north and south Etobicoke and to Downsview.

A method for estimating transportation energy consumption associated with new employment and residential developments was derived from existing data on travel patterns within Metro. Figure 3.1 is the Energy Rating (Employment) for locations within the Municipality.



SOURCE : 1979 Employee Survey
(Metropolitan Toronto)

FIGURE 3.1 :
1981 ENERGY CONSUMPTION RATING
OF EMPLOYMENT LOCATIONS.

The rating shown on Figure 3.1 is non-dimensional. The average rating for all Metro employment (weighted) is 99. That rating represents the average commuting trip to a job in Metro and accounts for average modal split, average auto travel time and average non-vehicular travel to work. That average trip is estimated to consume 1.43 litres per employee per one way trip or 660 litres per year. In the Background report a method is given to convert that rating to fuel consumption.

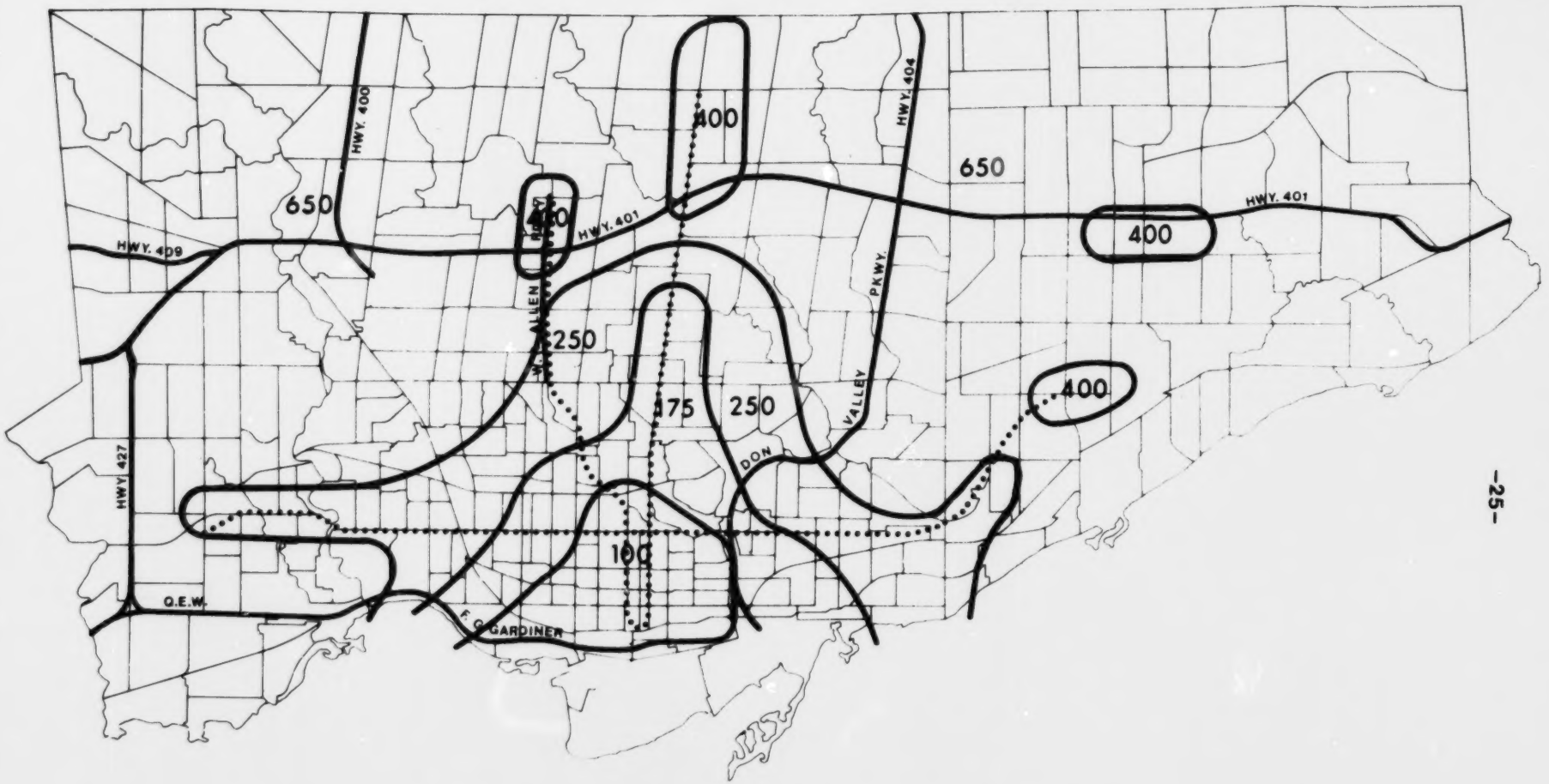
A similar analysis of the expected fuel consumption for travel associated with various residential redevelopment locations was undertaken. Figure 3.2 shows the fuel consumption for commuting expected at locations throughout Metro.

The patterns illustrated by these ratings are based on current travel patterns and the existing transportation infrastructure. Over the long term, these will change with the result that the rating of various locations within Metro will be altered. The ratings provide:

- a description of the relative energy efficiency of existing employment and residential locations;
- an aid to assessing the relative energy efficiency of new developments at locations within Metro;
- a method for deriving energy consumption levels associated with specific projects where modal split and auto travel times can be forecast with relative accuracy;
- a method for deriving the relative energy consumption changes induced by new rapid transit facilities within Metro.

3.3.3 Recommendations for Metroplan

The review of Metroplan from an energy perspective was conducted at two levels - against general principles of energy conservation and against more specific travel characteristics within Metro. The



00 - FUEL PER YEAR (in litres)
PER WORKER FOR COMMUTING.

SOURCE: 1979 Home Interview Survey
(Metropolitan Toronto)

FIGURE 3.2:
RESIDENTIAL REDEVELOPMENT LOCATIONS & EQUIVALENT COMMUTING FUEL CONSUMPTION (Conceptual).

recommendations on possible changes which could be made to the Plan to encourage the creation of more energy efficient travel patterns are made from an energy perspective and therefore do not necessarily take into account the numerous non-energy factors which are integral to the Plan. It is expected that the recommendations of this report will be considered into the scheduled review of Metroplan being undertaken in 1984/85:

- the Plan review should consider the desirability for a major centre in the north-west sector of Metro in conjunction with the planning of the east-west transit route in the area;
- a centre along the Spadina transit line should be included in long term land use and transit planning studies;
- in the detailed planning of Centres, particular attention should be given to pedestrian access, parking policies and the arrangement of land uses as described in this report;
- in reviewing applications for new regional shopping centres, Metro should have consideration for locations in areas not presently well served;
- Metro and Area Municipalities should examine opportunities for additional employment growth in areas west of Yonge Street;
- additional transit capacity within the Central Area (such as being examined under the Relief Line studies), should be considered but only to a level necessary to serve planned/committed development levels;
- parking policies which will encourage transit use should be introduced;
- physical connections for pedestrian movement (protected walkways) between the waterfront, Railway Lands and the subway system in the financial district should be incorporated into detailed development plans;

- a residential density policy should be prepared taking into account the findings of the study on residential locations which will provide opportunities for low energy travel. Specifically, the density policy review should include:
  - .. the potential for density bonusing at rapid transit stations
  - .. parking policies related to the level of transportation service available
  - .. encouragement for mixed use projects
  - .. encouragement for infilling throughout the Municipality
  - .. siting guidelines for detailed planning around rapid transit stations
  - .. dwelling unit conversion policy.

4. A CONTINGENCY PLAN STRATEGY FOR A FUEL SHORTAGE

4.1 Purpose

A fuel shortage similar to those experienced in many countries of the world in 1973 and 1979 is unlikely to occur in the near future. However, as long as Canada imports petroleum it will be vulnerable to supply disruptions. Therefore, being prepared for such an event is a prudent strategy for all levels of government, particularly those with direct responsibility for the provision of transportation services and management of the roadway system.

The role of Metropolitan Toronto Council and staff during a fuel shortage should be proactive, taking a leadership role in maintaining mobility within Metro and reducing the negative consequences to the public at having less fuel available. Metro should be ready to guide the travel habits of residents towards more efficient patterns, such as increased transit usage or carpooling. It should ensure that the sale of fuel at local service stations is conducted efficiently and without confusion and wastage from uncertainty as to fuel availability. It should also ensure that the transit system under its jurisdiction is operated in a way that provides an effective alternative to automobile travel. To ensure that automobile travel which is undertaken is done so in a fuel efficient manner, Metro should also be prepared to modify operating procedures on arterials and freeways, including reduced speed limits and traffic signal timing adjustments.

4.2 Approach

This part of M.T.A.T.E.S. II was originally intended to produce a detailed plan of action for each operating agency responsible for some aspect of transportation within Metro. During the study it was found

that a detailed plan could not yet be finalized because additional analysis and planning by the operating agencies was required. Since that work would necessitate expenditures by these agencies, it was concluded that a staged approach be used; first, the development of a coordinated framework or strategy for a fuel shortage followed by the completion of detailed components by operating agencies once approval in principle to this report was given. For these reasons this part of the study is entitled a Contingency Plan Strategy. Once the additional detailed planning by operating agencies is completed, the components will become the Corporation's Contingency Plan for a fuel shortage affecting transportation within Metro.

The strategy establishes a logical response by Metro to reduced fuel supplies. It provides the means whereby Council can:

- assist individuals in achieving levels of mobility near those enjoyed during normal fuel supply conditions;
- reduce uncertainty and waste related to the sale of vehicle fuel within the Municipality;

4.3 Findings

The need for specific actions by Metro during a fuel shortage are based on the expected impact of fuel reductions on Metro residents and employees. Targets were developed for 3 levels of fuel reduction (see Table 4.1). These are considered representative of the possible range of shortages which could arise in Metro, including the most severe situations.

These planning targets indicate that some local trips will not be taken during a fuel shortfall, reflecting the public's willingness to reduce discretionary travel, particularly in the short-run. In the long-run, the

TABLE 4.1

MOBILITY REPLACEMENT TARGETS
(NUMBER OF LOCAL DAILY AUTO TRIPS)

SHORTFALL LEVEL	SHORT TERM				LONG TERM			
	TOTAL TRIPS REPLACED	WORK*	NON-WORK	TRIPS NOT REPLACED**	TOTAL TRIPS REPLACED	WORK*	NON-WORK	TRIPS NOT REPLACED**
Level 1 - 5% reduction	70,000	25,000	45,000	15,000	78,000	35,000	43,000	2,000
Level 2 - 10% reduction	115,000	53,000	62,000	55,000	140,000	70,000	70,000	7,000
- 15% reduction	120,000	80,000	40,000	115,000	200,000	105,000	95,000	15,000
Level 3 - 20% reduction	250,000	100,000	150,000	130,000	340,000	140,000	200,000	40,000
- 25% reduction	320,000	125,000	195,000	155,000	405,000	175,000	230,000	70,000

* These estimates are below the corresponding data in Table 2.5 of the Contingency Plan Strategy Backgound Report to account for the use of more efficient vehicles for some work trips.

** From Figures 2.3 to 2.7 in Contingency Plan Strategy Background Report

goal is to replace most potential mobility losses[1] resulting from a fuel shortfall.

4.3.1 Measures Proposed

The Strategy describes the set of measures which could be employed during a fuel shortage. The selection of these measures was based on the experiences of other agencies during previous shortages and the specific characteristics of the transportation system within Metro.

The measures proposed in the Contingency Plan Strategy have the potential to meet the planning targets established. Measures designed for work travel can replace up to 180,000 daily trips which would otherwise not be taken because of lack of fuel. For non-work travel, the measures can replace up to 230,000 daily trips. This performance level is therefore sufficient to minimize the consequences of even the most severe fuel shortage, a 25% reduction. Table 4.2 lists the mobility replacement potential of each measure.

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1. The Tables 4.1 and 4.2 and subsequent discussion in this report use the term mobility loss and replacement measured in trips. This was found to be a convenient common denominator by which to express planning targets and compute the effectiveness of each action proposed in this Strategy. The term is based on the concept that when a fuel shortage occurs, reduced fuel availability will be manifested in less travel in some or all of the modes presently used, primarily private automobile. That reduced travel is termed a 'loss in mobility' and would remain if people did not find alternatives to the private auto as currently used for some of their travel needs. Those alternatives, such as transit or carpooling, can substitute for some of the automobile travel which cannot be taken because of the reduction in the amount of fuel available. The performance of the specific actions prepared in this strategy is measured in their ability to substitute for travel which would otherwise be forsaken due to lack of fuel. The performance measurement is termed 'mobility replacement' to reflect the fact that it is substituting for the use of private automobiles as a means for providing mobility to Metro's residents. The unit of measurement is in person trips previously undertaken by private automobile.

TABLE 4.2

POTENTIAL FOR MOBILITY REPLACEMENT

Measure	Daily Work Trips #	Daily Work Trips %	Daily Non-Work Trips #	Daily Non-Work Trips %
Modifying Travel Demand				
. information on efficient trip planning and reduction of discretionary travel			64,000	28
. increased use of shoulder travel periods for transit	15,000[1]			
Promoting Ridesharing				
. employer assistance program	50,000	27.5		
. area wide ride matching service	40,000	22.5	40,000	17
Extending Transit Service				
. increase the in-service fleet . increase use of shoulder travel periods for transit . relief bus service . increased usage of current service	50,000	27.5	70,000	31
Modifying Traffic Operations and Controls				
. optimized signal timings	27,000	15.0	39,000	17
. reduced speed limits	13,000	7.5	11,000	5
. other	-	-	5,000	2
Total	180,000	100.0	230,000	100.0

1. Included in the 50,000 work trips replaced by extending transit use.

The measures proposed must be implemented in a coordinated manner by the operating agencies within Metro. The Strategy therefore anticipates the preparation of specific action plans by each operating agency and the designation of a Plan Coordinator to monitor the subsequent detailed planning stage, update the Plan and coordinate implementation. The Contingency Plan Coordinator's responsibility could most effectively be undertaken by a staff member of the Planning Department.

The main elements of the Contingency Plan Strategy are presented in the following sections. In Table 4.2 the performance of each measure is summarized.

4.3.1.1 Modifying Travel Demand

Under lower levels of fuel supply, automobile travel will be reduced by an amount approximately equal to the level of fuel reduction. In the short-run, the public will likely reduce discretionary local travel and avoid weekend/vacation travel. During higher level or long-term shortfalls, work travel will be affected. With some assistance from governments and service groups, most people can adjust to reduced automobile travel through better organization of travel, substituting more efficient modes and eliminating wasteful travel. The government role in reducing the demand for automobile travel is primarily informational: providing the public with encouragement and knowledge to enable them to adjust their travel habits in a manner which will maintain a high degree of mobility, but use less fuel.

It is therefore proposed that:

- Metro provide the necessary information to the general public to enable them to reduce travel through efficient trip planning and the reduction of discretionary travel;

- obtain higher utilization of the transit system capacity by encouraging more shoulder period travel through such means as variable work hours.

4.3.1.2 Promoting Ridesharing

The evidence from shortages in other areas indicates that voluntary carpooling will account for a large part of the public's adjustment to lower fuel supply levels. In addition to encouraging such behaviour through promotional programs, Metro should directly assist employers and individuals in organizing carpools and vanpools.

Actions to be taken during a fuel shortfall are:

- provide assistance to major employers in initiating or expanding carpooling programs for their employees
- providing a ride matching service to the general public whereby they can locate drivers willing to carpool

The ability to provide such a service during a fuel shortage requires extensive preparation during normal fuel supply conditions. Setting up carpooling networks at major employers and the development of a data base for public ride matching service could not be undertaken on the 'eve' of a shortage. The preparation process required will include a demonstration project to develop the appropriate techniques for setting up a carpooling program, the implementation of a Metro wide ridesharing program during normal fuel supply conditions and then if needed, accelerating and extending that program to meet additional demand caused by a fuel shortage. Fortunately, such an extensive preparation phase would also produce immediate benefits in energy conservation, as recommended in Chapter 2.

To coordinate the recommended ridesharing program, a Rideshare Coordinator should be designated. The responsibility of that individual would initially be the management of a demonstration project. Depending on the results of that project, responsibilities could extend to coordination of an area wide rideshare program within Metro.

During a fuel shortage he would work closely with the Contingency Plan Coordinator in implementing an extended ridesharing service.

4.3.1.3 Extending Transit Service

The transit system will be looked to as a potential replacement for reduced automobile travel. At very little energy cost, a considerable amount of lost mobility can be replaced by transit, including the T.T.C., GO Transit and intercity bus/rail systems. Metro's role in transit during a fuel shortfall is direct: system capacity expansion where possible, service improvements in off-peak periods and promotion of transit usage.

It is expected that Metro residents will look favourably to the transit system as an alternative to automobile travel. The existing physical availability of transit to all residential and employment areas and the social acceptability of public transit travel indicate significant increases in ridership if system capacity can be made available.

The Contingency Plan Strategy proposes that during a fuel shortage, the T.T.C. implement the following:

- increase the in-service fleet during a fuel shortage through the use of available vehicles and revised maintenance schedules;
- expand service in the shoulder period in conjunction with the promotion of variable work hours;
- provide relief bus service to provide additional north-south capacity in the Yonge Street corridor south of Bloor.

In preparing this Strategy, extensive analysis of the potential for the T.T.C. to undertake these actions was undertaken. The remaining task is for the T.T.C. to develop the detailed operating and staffing plans necessary to implement the recommended Strategy.

4.3.1.4 Vehicle Efficiency and Traffic Operations

The operating efficiency of automobiles is affected by weight and engine design and by the operating efficiency achieved in urban travel. To get the most travel out of the fuel available to them, individuals are expected to respond in the following manner to reduced fuel supplies:

- use the most fuel efficient vehicles available to them in the short-run; and
- purchase more fuel efficient vehicles if the shortage is expected to be long term or recurring.

The Municipality also has a role in ensuring that automobile travel is fuel efficient as it controls the traffic operation systems which affect overall vehicular travel efficiency.

Specifically, this Strategy recommends that during a fuel shortage Metropolitan Toronto Roads and Traffic and the Ministry of Transportation and Communications implement the following:

- adjust traffic signal timings to the sequences which optimize vehicle fuel efficiency along major signal controlled routes;
- reduce speed limits on Metro's freeways.

4.3.1.5 Promoting Efficient Sale of Fuel

The measures described above are intended to meet the objective of assisting individuals in achieving levels of mobility near pre-shortage conditions. A second Metropolitan objective during fuel shortages, is to reduce uncertainty and waste related to the local sale of fuel.

Public anxiety over the actual nature of the shortfall being experienced can cause near panic situations just to top-up the tank. Line-ups are extremely wasteful in time and fuel, and through the congestion and delays created, contribute in a large way to the loss of mobility and economic impact usually experienced during a fuel shortage.

Metro can alleviate disruptions related to the supply and purchase of fuel within Metro, through the provision of up-to-date information on the extent and nature of the shortage, permitting service stations to remain open for longer hours, providing aid to stranded motorists and other supply related measures.

To achieve the objective of the Contingency Plan, it is proposed that:

- appropriate by-laws be passed to enable Metro and Area Municipal councils to permit extended service station hours during a fuel shortage;
- filling station dealers and oil companies be requested to implement a flag notice system at service stations to identify those stations which do not have fuel available;
- Metro police be requested to control congestion near service stations.

4.3.2 Responsibilities During a Fuel Shortage

The effectiveness of the Corporation's response to a fuel shortage will depend on the actions of a number of operating departments and agencies. Table 4.3 summarizes the specific actions to be undertaken. As shown in the Table, the Contingency Plan Coordinator is a key individual in the implementation stage. He must obtain approvals for action from Council, provide on-going liaison between the Corporation and other levels of government and the press and he must monitor and adjust the Plan based on its effectiveness.

4.3.3 Future Action

This Strategy identifies the specific actions which should be taken during a fuel shortage. As already indicated, however, additional detailed planning, staffing and approvals must be obtained before a final Contingency Plan is complete and Metro is therefore fully prepared to meet a fuel shortage. These are summarized in Table 4.4.

The remaining steps to be taken are as follows:

- Metro Council to approve-in-principle this Strategy and authorize the remaining tasks;
- a Contingency Plan Coordinator to be appointed;
- operating agencies to undertake remaining detailed planning tasks;
- approval and funding for a ridesharing demonstration program to be obtained;
- the final Plan to be formalized by the end of 1984;
- Council to give final approval to the Contingency Plan.

It is clear that a cooperative effort among several agencies is required to prepare Metro for an energy emergency and if necessary, to implement a Contingency Plan. The adoption of this Strategy by Council will provide the direction required to achieve that end.

TABLE 4.3

ACTION PLAN DURING AN ENERGY SHORTFALL

	SHORTFALL LEVEL		
	1(less than 5%)	2(5-15%)	3(-20%)
Contingency Plan Co-ordinator			
. obtain approvals for actions	o	o	o
. authorize production and distribution of information packages	o		
. prepare press releases	o	o	o
. implement fuel supply information program	o	o	o
. implement filling station flag system		o	o

TABLE 4.3

ACTION PLAN DURING AN ENERGY SHORTFALL

	SHORTFALL LEVEL		
	1(less than 5%)	2(5-15%)	3(-20%)
. request Metro Police control of filling station congestion	o	o	o
. obtain approvals for extended service station hours		o	o
. obtain approval for mandatory staggered work hours for municipal employees		o	
. implement information program with rationing			o
. monitor situation and update agencies	o	o	o
. provide intergovernmental liaison	o	o	o
Toronto Transit Commission			
. promotion of variable work hours	o	o	o
. produce information packages	o		
. provide route and schedule information service	o	o	o
. employ revised maintenance and staffing plans	o		
. add vehicles to existing routes	o		
. add relief bus routes		o	

TABLE 4.3 (Continued)

ACTION PLAN DURING AN ENERGY SHORTFALL

	SHORTFALL LEVEL		
	1(less than 5%)	2(5-15%)	3(-20%)
. reschedule service		o	
. add off-peak service			o
. monitor demand and capacity information	o	o	o
Rideshare Coordinator			
. re-establish employer contacts	o		
. increase capacity to provide matching service to employers	o		
. provide necessary ride-sharing information to Plan Coordinator	o		
. initiate area wide matching service to the public		o	
. reallocate staff from Metro departments		o	o
Metro Roads and Traffic			
. obtain approval for 10 km/hr reduction for freeway speeds	o		
. implement revised signal timing plan		o	
. request MTC to reduce Provincial freeway speeds - by 10 km/hr	o		
by 20 km/hr		o	
Metro Police			
. control congestion at filling stations	o	o	o

TABLE 4.4

REQUIREMENTS FOR PLAN FINALIZATION

MEASURE	ACTION REQUIRED	RESPONSIBILITY
MODIFYING TRAVEL DEMAND		
. prepare draft information packages on methods for reducing travel needs and fuel consumption	. coordination with senior governments on their information programs; development of Metro specific materials and information inquiry service; establishment of production plan for printing and distributing information packages.	Planning Department., T.T.C. Marketing and Community Relations Department
	. determine budget and scheduling requirements to produce information. Determination of costs for expanded public inquiry service	
. variable work hours	. obtain agreement from Municipal, Provincial and Federal government agencies for possible mandatory staggered work hours.	Planning Department
PROMOTING RIDESHARING		
. demonstration project and area wide ridesharing service	. obtain agreement from M.T.C. to undertake a demonstration project and area-wide ridesharing program	Planning Department
EXTENDING TRANSIT SERVICE		
. relief bus routes	. develop detailed route and operating plans	T.T.C.
. shoulder period service expansion	. develop staffing and scheduling requirements for 10 to 30% shoulder period demand increases	T.T.C.
. additional manpower	. develop contingency staffing plans with labour unions.	T.T.C.

TABLE 4.4

REQUIREMENTS FOR PLAN FINALIZATION

MEASURE	ACTION REQUIRED	RESPONSIBILITY
MODIFYING TRAFFIC OPERATIONS AND CONTROL		
• energy optimizing traffic signal timing plan.	• prepare signal timing plan	Roads and Traffic Department
• reduced speed limits	• undertake preliminary arrangements for revised speed limits (enabling by-laws and signs)	Roads and Traffic Department
	• request M.T.C. to prepare a plan for reduced speed limits on their freeways within Metro	Roads and Traffic Department
PROMOTING EFFICIENT SALE OF FUEL		
• by-laws permitting extended service station hours during a fuel shortage	• prepare "model" by-law; request area municipalities to pass enabling by-laws	Planning Department
• flag notice system	• develop flag notice systems with major oil companies and dealers associations	Planning Department
• traffic control at filling stations	• discussions with Metro Police on requirements; preparation of contingency manpower assignments	Planning Department Metro Police
• fuel availability monitoring system	• request senior governments to develop a fuel supply monitoring system	Planning Department

5. CONCLUSIONS

The first phase of M.T.A.T.E.S., completed in December 1980, determined the energy consumption of the various transportation modes in Metropolitan Toronto and developed future scenarios of energy consumption. Based on this background, Phase II of the Study has demonstrated that Metropolitan Toronto can significantly influence energy use for transportation within the Municipality, thereby reducing present fuel consumption rates. A set of recommended energy conservation measures related to the improvement of the traffic signal system was approved by the Metropolitan Council in mid-1983 and is being implemented Metro-wide. An additional package of complementary and low cost energy conservation measures is now being recommended for implementation. In total, these are expected to reduce areawide fuel consumption by 2.1 to 2.7% , for a financial savings of $60 million to $75 million per year. The monitoring of the measures which have been implemented, has confirmed that they are significant energy savers.

The findings on energy conservation opportunities through transportation and land use planning, sets the principles and direction which the Corporation should follow in guiding long term changes to the urban structure. These findings, extend the impact of the study well beyond the time frame of the proposed short term conservation measures and into the major land use pattern and transportation system factors which will influence the amount and mode of travel in the future. These recommendations are timely and can readily be incorporated into the Official Plan review and the various transportation planning studies currently being undertaken.

The proposed Contingency Plan Strategy includes several measures which are similar to those recommended for implementation in the short term. These measures would allow Metro to quickly implement the recommended steps in the Contingency Plan Strategy during a fuel shortage. During such a shortage, these measures (such as ridesharing) and others would be applied on a wider basis, to effectively deal with the impacts of the reduction in the availability of fuel.

With proper preparation and execution of the steps described in the Strategy, most work, shopping and leisure travel will still be possible, even under the most critical fuel reduction scenarios.

Since the initiation of M.T.A.T.E.S. (Phase I) in 1980, the energy supply scene has changed dramatically. The urgency to reduce our use of and dependency on petroleum based fuels has waned. However, it is also clear that present energy costs are higher than in the past, and that as a nation, Canada is still vulnerable to energy supply disruptions. The coming years and decades will certainly bring changes in the many economic, environmental and political aspects which influence energy supplies and prices; the long term trend seems to point towards reduced supplies and higher prices for conventional transportation fuels. Implementation of the recommendations of M.T.A.T.E.S. will place Metropolitan Toronto and its residents in a much better position to accommodate and adapt to major price or supply changes in the future.

APPENDIX A

REPORT TO TRANSPORTATION COMMITTEE

RE: MEASURES FOR IMPLEMENTATION IN 1983

The Municipality of
Metropolitan Toronto

Planning Department

May 17, 1983

TO: METROPOLITAN TRANSPORTATION COMMITTEE

RE: METROPOLITAN TORONTO AREA TRANSPORTATION ENERGY STUDY - PHASE II; PROPOSED CONSERVATION MEASURES FOR 1983

Introduction

At its meeting of June 23,1981, Metropolitan Council granted authority to proceed with Phase II of the Metropolitan Toronto Area Transportation Energy Study, and to engage consultants to assist in the conduct of such study, (Clause No.1 of Report No.10 of the Economic Development and Planning Committee). The study is being jointly undertaken by the Planning Department, Roads and Traffic Department and the Toronto Transit Commission. An agreement with the Ministry of Transportation and Communications provides full recovery of the required consulting assistance which represents 75% of the total study cost. The balance of 25% of the total study cost, is comprised of staff contributions of the three aforementioned Metropolitan agencies. The Phase II Study consists of three parts:

Part I	-	Examination of Land Use/Transportation Energy Relationships;
Part II	-	Development of a Transportation Energy Contingency Plan;
Part III	-	Development of an Implementation Plan for Short Term Conservation Measures.

The analyses for the three study Parts are being conducted concurrently and it is anticipated that Parts I and II will be completed in the near future. Part III of the study, was further sub-divided into the analysis of energy conservation measures which could be implemented in three time-frames: 1983, 1984 and 1985-1987. This was done so that obvious fuel saving measures to be identified, could be implemented at the earliest time. The attached interim report (Appendix A) documents the analysis of measures which could be implemented in 1983, while further analysis continues for measures to be implemented in 1984 to 1987.

Proposed Conservation Measures for 1983

Within the analysis of conservation measures, the Study framework provided for the identification of measures which, as a result of their high energy conservation potential, low cost and perceived ease of implementation, could be implemented in 1983.

The review of these measures indicated that the highest benefits in terms of energy savings, could be achieved with the introduction of measures which optimize traffic flows on the arterial/collector road system. In particular, the analysis revealed that three specific measures which optimize the operation and timing of traffic signals, could achieve significant energy savings:

(1) optimized traffic signal timings;
(2) conversion to or enhancement of semi-actuated traffic signals;
(3) variable traffic signal phasing throughout the day.

Discussions conducted with Roads and Traffic staff revealed that these measures are presently being implemented (or are being considered for implementation). However, due to Departmental budget constraints the rate of implementation of these measures is not as fast as desired. It should be noted that improvements to the traffic computer control and the traffic signal systems, are eligible for a 50% subsidy from the Ministry of Transportation and Communications (M.T.C.), and subject to a maximum upset limit which has been reached for 1983.

The combined energy savings which these measures could achieve, is estimated at about 3.5% savings areawide or about 100 million litres of fuel per year. Accordingly, Metro Council should consider accelerating the implementation programs for the proposed measures.

Cost and Benefits of an Accelerated Implementation Program

Accelerated programs have been developed for each proposed measure, in consultation with Roads and Traffic staff. Attached Table 1 details the additional annual costs of instituting the proposed implementation program which would be completed in five years.

The cost indicated for the implementation of the computer optimized timing program is related to the labour required to undertake the necessary intersection counts to create and adequately maintain the computer program data base. Roads and Traffic staff have estimated that to maintain the continuous update of traffic counts needed for this program, an increase of 2 permanent fieldmen to the establishment of strength for the Department would be required.

An inventory of signalized intersections was conducted by Roads and Traffic staff, to determine the number and location of traffic signal enhancements and the associated costs which could be implemented in 1983, based on the requirements at particular locations, and the availability of staff to undertake the work. The costs shown for the measures which enhance the traffic signal system include hardware and construction contracting costs. Table 2 indicates the locations proposed for enhancement of existing semi-actuated control signals; Table 3 shows the locations proposed for conversion of signals from fixed-time to semi-actuated control; and Table 4, shows the locations proposed for conversion from Fixed-Advanced-Green to Demand-Responsive-Advanced-Green. The tables also detail the estimated costs by individual location associated with the implementation of these measures. The ability to initiate and complete this program in 1983 as proposed, is subject to the prompt approval of the funds required by the Roads and Traffic Department to implement the measures in the summer season. These funds could be secured by requesting M.T.C. and Metro Council for additional funds for the implementation of these measures.

Implementation of all elements of the program would require that an additional $332,000 be made available to the Traffic Control Centre in 1983. The benefit to the general public achieved as a result of the proposed program would translate into a savings of about 17 million litres or 6 to 8 million dollars in 1983. As indicated in Table 1, and based on the detailed costs for 1983, the annual costs for the following years have been estimated at $436,000 for 1984; $489,000 for 1985 and 1986; and $413,000 for 1987. Upon completion of the program, it is estimated that the 100 million litres per year which could be conserved, would represent a savings to the general public of 40 to 45 million dollars. This would translate into an annual savings in gasoline expenditures of $50 to $60 per household in Metro.

Recommendations:

It is recommended that:

(1) Metropolitan Council be requested to approve the accelerated implementation program for:

- optimized traffic signal timing;
- conversion to and enhancement of semi-actuated traffic signals; and
- variable traffic signal phasing throughout the day

as proposed in this report.

(2) Metropolitan Council be requested to provide funds in the amount of $332,000 in the Roads and Traffic Department 1983 Current Estimates, for the accelerated implementation program, subject to:

(a) obtaining additional funds from M.T.C. to subsidize this program at a rate of at least 50 per cent.;

(b) obtaining approval from the Budget Sub-Committee to provide contingency funds not to exceed $332,000 for this purpose.

(3) the establishment of strength for the Roads and Traffic Department be amended by the addition of 2 traffic fieldmen;

(4) the appropriate Metropolitan officials be authorized to take whatever action necessary to give effect thereto.

R.J. Bower
Commissioner of Planning

S. Cass
Commissioner of Roads and Traffic

A.H. Savage
Chief General Manager
Toronto Transit Commission

TABLE I.

ANNUAL APPLICATIONS AND COSTS[1] OF ACCELERATED IMPLEMENTATION PROGRAM

Ranking	Measure	Reduction in Energy Consumption Areawide	1983		1984		1985		1986		1987		Energy Savings Per year (litres)
			Appl.	Cost	Appl.	Cost	Appl.	Cost	Appl.	Cost	Appl.	Cost	
1	Computer Optimized Timing	1.5%	200	$ 40,000	350	$ 70,000	350	$ 70,000	350	$ 70,000	200	40,000	42,000,000
2	Enhancements to existing semi-actuated (S.A.)control	1.34%	40	$ 66,000	40	$ 66,000	40	$ 66,000	40	$ 66,000	40	$ 66,000	37,500,000
3	Conversion of fixed time to enhanced S.A. control	0.64%	13	$138,000	20	$212,000	25	$265,000	25	$ 265,000	20	$ 212,000	18,800,000
4	Conversion of Fixed Advanced Green to Demand Responsive Advanced Green	0.17%	60	$ 88,000	60	$ 88,000	60	$ 88,000	60	$ 88,000	65	$ 95,000	4,700,000
	TOTAL ANNUAL COSTS ABOVE EXISTING PROGRAM			$332,000		$436,000		$489,000		$ 489,000		$ 413,000	

(1) Over and above existing programs in 1983 dollars

TABLE 2

SIGNALS RECOMMENDED FOR ENHANCEMENT FROM SEMI-ACTUATED TO SEMI-ACTUATED CONTROL-II

	LOCATION	REQUIRED MODIFICATION[1]	ESTIMATED COST ($)
1.	Weston & Ormont	A-B	2,400
2.	Kipling & Mt.Olive/Panorama	A-B	2,800
3.	The West Mall & West Mall Cres	A	1,200
4.	Bathurst & Bainbridge	A-B	2,400
5.	Lawrence & Howden	A	800
6.	Keele & Rustic	A-B	2,400
7.	Finch & John Garland/Silverstone	A	2,400
8.	Finch & Talbot	A-B	2,000
9.	Finch & Kenneth	A	1,800
10.	Yonge & Woodlawn	A	1,600
11.	Morningside & Coronation	A-B	2,400
12.	Jane & Harding	A	800
13.	Keele & Toro	A	800
14.	Bloor & Havelock	A	800
15.	Jane & Ardagh	A	800
16.	College & Crawford	A-B	2,400
17.	Bathurst & Ellerslie/Carscadden	A	2,000
18.	Bathurst & Neptune	A-B	1,200
19.	Bathurst & Horsham/Blue Flag Gate	A	1,600
20.	Bathurst & Cedarcroft/Patricia	A	1,600
21.	Bathurst & Yorkdowns	A	2,000
22.	Bayview & Empress/Citation	A-B	2,400
23.	Bayview & Ruddington	A	1,600
24.	Bloor & Clendennen	A-B	1,200
25.	York Mills & Valentine/Silverdale	A	2,000
26.	York Mills & Banbury/Chipstead	A-B	2,400
27.	Yonge & Rosehill	A	800

TABLE 2 (Cont.)

	LOCATION	REQUIRED MODIFICATION(1)	ESTIMATED COST ($)
28.	West Mall & Eva	A-B	2,000
29.	Steeles & Lauraleaf	A	1,600
30.	Steeles & Maxome/Henderson	A-B	2,400
31.	St.Clair & Avoca	A-B	1,200
32.	Sheppard & Rivalda	A	2,000
33.	Sheppard & Chesswood	A-B	1,200
34.	Runnymede & St.Johns	A	1,600
35.	Dundas & Windermere	A	800
36.	Dufferin & Bowie	A-B	1,200
37.	Dufferin & Shanly	A	800
38.	Eglinton & Bicknell	A	800
39.	Eglinton & Blackthorn	A-B	1,200
40.	Eastern & Knox	A	2,400

(1) A- Loop Installation
B- Detector Kit

TABLE 3

SIGNALS RECOMMENDED FOR ENHANCEMENT FROM FIXED TIME TO SEMI-ACTUATED CONTROL

	SIGNAL NO.	LOCATION	CONTROLLER TYPE[1]	ESTIMATED COST ($)
1.	352	Danforth & Gledhill/Patricia	E.M.	14,000
2.	284	Dundas & Woodfield	E.M.	14,000
3.	127	Yonge & Church/Churchill	E.M.	14,000
4.	373	Gerrard & Logan	E.M.	14,000
5.	290	Dundas & Logan	S.S.	4,500
6.	817	Eastern & Broadview	E.M.	14,000
7.	654	Dawes & Secord	E.M.	14,000
8.	655	Dawes & Gower	E.M.	14,000
9.	371	Gerrard & Pape	E.M.	14,000
10.	835	Harbord & Grace	S.S.	4,500
11.	855	Duplex & Glengrove	S.S.	6,000
12.	854	Duplex & Castlefield	S.S.	6,000
13.	350	Danforth & Glebemount	S.S.	4,500

(1) E.M. - Electro-Mechanical
S.S. - Solid State

TABLE 4.

SOLID STATE SIGNALS WITH 24 HOUR ADVANCED GREENS
ENHANCED TO CALLABLE BY INSTALLING DETECTORS IN LEFT TURN LANE

	SIGNAL NO.	LOCATION	APPROACH	ESTIMATED COST ($)
1.	185	Dundas & Jane	SB	1,200
2.	750	Warden & Sheppard	WB	1,200
3.	672	Bathurst & Sheppard	NB/WB	2,100
4.	461	Eglinton & Midland	EB	1,200
5.	568	Kipling & The Queensway	NB/WB	2,100
6.	699	Ellesmere & McCowan	SB/EB	2,100
7.	744	Sheppard & Leslie	NB/WB	2,100
8.	337	Bloor & Prince Edward	WB	1,200
9.	102	Eglinton & Marlee	EB	1,200
10.	1256	Steeles & Kipling	WB	1,200
11.	634	Don Mills & Duncan Mill	NB	1,200
12.	427	Lawrence & Caledonia	EB	1,200
13.	96	Avenue & Eglinton	SB	1,200
14.	748	Sheppard & Victoria Park	WB	1,200
15.	355	Danforth & Victoria Park	WB	1,200
16.	471	St.Clair & Victoria Park	WB	1,200
17.	517	Ellesmere & Victoria Park	WB/SB	2,100
18.	407	Lawrence & Victoria Park	NB/WB	2,100
19.	451	Eglinton & Victoria Park	EB/SB	1,200
20.	449	O'Connor & Victoria Park	EB/WB	2,100
21.	412	Lawrence & Kennedy	SB	2,700
22.	687	Millwood & Overlea	SB	1,200
23.	452	Eglinton & Pharmacy	EB	1,200
24.	169	Bayview & Moore	WB	1,200
25.	706	Dundas & Islington	EB	1,200
26.	864	Victoria & Consumers	NB	1,200
27.	531	Jane & Falstaff	SB	1,200

TABLE 4 (Continued)

	SIGNAL NO.	LOCATION	APPROACH	ESTIMATED COST ($)
28.	475	Kennedy & St.Clair	EB	1,200
29.	786	Eglinton & Martin Grove	EB/	1,200
30.	400	Lawrence & Leslie	WB/SB	2,100
31.	402	Lawrence & Don Mills	WB	1,200
32.	90	Bayview & Eglinton	WB/SB	2,100
33.	633	Keele & Grandravine	NB	1,200
34.	413	Lawrence & Midland	EB	1,200
35.	648	Bayview & Sheppard	NB/WB	2,100
36.	1407	Allen & Sheppard	NB/WB	2,100
37.	380	Lawrence & McCowan	WB	1,200
38.	503	Lawrence & Crockford	WB	1,200
39.	597	Keele & Wilson	NB/WB	2,100
40.	404	Lawrence & Underhill	EB	1,200
41.	406	Lawrence & Curlew	EB	1,200
42.	632	Laird & Millwood	NB	1,200
43.	570	Queensway & Atomic	EB	1,200
44.	532	Jane & Wilson	NB	1,200
45.	351	Danforth & Woodbine	WB/SB	2,100
46.	810	Finch & Signet	WB	1,200
47.	626	Don Mills & York Mills	NB/WB	2,100
48.	434	Dixon & Islington	SB/EB	2,100
49.	755	Leslie & York Mills	SB/WB	2,100
50.	752	Kennedy & Sheppard	WB	1,200
51.	631	Wilson Hts & Sheppard	WB	1,200
52.	525	Jane & Alliance	SB	1,200
53.	614	Dufferin & Orfus	NB	1,200
54.	693	Pharmacy & Ellesmere	WB	1,200
55.	408	Pharmacy & Lawrence	WB	1,200
56.	356	Danforth & Pharmacy	EB	1,200
57.	430	Jane & Lawrence	NB	1,200
58.	760	Warden & Hwy 401 N.	NB	1,200
59.	761	Warden & Hwy 401 S.	SB	1,200
60.	694	Warden & Ellesmere	SB	1,200

APPENDIX A

METROPOLITAN TORONTO AREA TRANSPORTATION ENERGY STUDY

PHASE II

PROPOSED CONSERVATION MEASURES FOR 1983

(A) INTRODUCTION

The second phase of the Metropolitan Toronto Area Transportation Energy Study (M.T.A.T.E.S.) has, as one of its principal objectives, the selection of transportation energy conservation measures which, due to their high energy conservation potential, relative low cost and ease of implementation, could be introduced in 1983. This report identifies these measures and proposes an implementation program to be initiated during 1983. The detailed technical analysis in support of these recommendations is documented under separate cover in a report prepared by the study team and entitled "Preliminary Assessment of Energy Conservation Measures."

A detailed computer-based analysis resulted in the estimate that the energy equivalent of approximately 2.8 billion litres of gasoline is consumed annually by all vehicles operating on the public transit and road systems in Metro Toronto. Energy expended in vehicle operations is referred to as direct transportation energy. At current fuel prices, the cost of this direct transportation energy consumption is approximately $1.2 billion annually.

(B) PROFILE OF ENERGY CONSUMPTION IN METRO

The energy consumption profile for Metro developed through the computer-based analysis mentioned above, is presented in Exhibit 1.1. Herein the proportion of total direct energy used in the transportation sector in Metro is presented by facility type and by traffic control device. Public transit accounts for only 3.5% while private vehicles (autos, trucks and motorcycles) account for 96.5% of all direct energy consumed on the transportation system in Metro. Approximately 62.5% of the total transportation energy in Metro is expended on the arterial and collector

road system. Freeways account for 26.7% of the total and local roads only 7.3%. Stops and delays at traffic signals on the arterial/collector road system account for 31.9% of all direct transportation energy consumed annually in Metro.

Based on this profile of energy consumption within Metro, it is clear that conservation strategies should be focussed primarily on the roadway system and within that category, towards the arterial/collector system and the freeway system. It is also clear that the strategies which could improve the efficiency of the traffic signal control system could have far reaching benefits in reducing energy consumption.

(C) EVALUATION OF CONSERVATION MEASURES

In deriving a set of short term conservation measures to be implemented in 1983, the principle objective was to select measures which could be implemented at low cost, but would yield a high energy saving. The measures recommended in this report achieve that objective.

The criteria used in reviewing the many possible measures which could be implemented within Metro Toronto are:

- short lead time to bring the measures on stream during 1983;
- few institutional obstacles to implementation;
- high energy saving potential;
- maintain or enhance existing safety standards.

Based on the analysis summarized in Exhibit 1.2, the measures which offer the most significant energy conservation potential are:

(1) optimized traffic signal timings;
(2) conversion to and enhancement of semi-actuated traffic signals;
(3) variable traffic signal timing throughout the day.

These three measures are all of a similar nature; that is dealing with signal timings and hardware used on the Metro road system. The potential savings associated with these is 3.5% of the total annual transportation energy consumption. That reduction represents in excess of 100 million litres of gasoline per year and a cost saving of approximately $45 million per year. This level of savings would not accrue until the measures have been applied throughout the Metropolitan area which may require a phased implementation program over a number of years to provide the signal hardware and timing plans necessary to achieve this benefit.

(D) EXISTING IMPLEMENTATION PROGRAMS

The proposed measures are either being implemented by Metro Roads and Traffic at the present time or are under consideration for future implementation. These measures and the status of the existing implementation programs are discussed below.

(1) Computer Optimized Timing

This measure deals with improvements in fuel consumption resulting from the implemention of signal timings in a coordinated network of signals which have been optimized to minimize a combination of vehicle stops and delays.

The SSTOP computer signal timing optimization program has been mounted on the Traffic Control Centre (T.C.C.) new traffic computer and is available for use as soon as adequate data can be assembled to provide input to the program. The major missing data are full intersection counts at all signal locations, particularly for the a.m. peak hour.

Once a comprehensive set of traffic counts is available for a particular area, the SSTOP program may be run to develop optimized signal timings for the particular area. Since the present version of SSTOP has a capacity limit of 50 signals, the Metro signal system will have its timings updated in blocks of 50 or less signals. It is

estimated that, with current office staff levels at the T.C.C., it will take approximately one month per 50 signal block to develop optimized signal timings using SSTOP and implement those in the field once the traffic count information is available. At this rate, it will take approximately 2.5 years to update the timing plans at all of the more than 1450 signalized intersections in Metro.

It should be noted that a new traffic count program now being undertaken by the Traffic Investigations Division of Metro Roads and Traffic will provide a.m. peak, p.m. peak, noon and mid-day off peak traffic counts at every signalized intersection once every two years. This provides approximately 720 traffic counts per year at signalized intersections in Metro. Were it possible for the T.C.C. to specify those locations desired in blocks of 50 signals at a time, the T.C.C. could proceed almost immediately with updating the existing signal timings by application of SSTOP with the counts as they are received (at the rate of 60 locations per month). Unfortunately, the new count program does not presently provide this flexibility, and therefore the T.C.C. must await the completion of a large portion of the count program before proceeding with the application of SSTOP. Discussions with Roads and Traffic staff have determined that an annual rate of 300 to 400 counts per year for this proposal could be achieved.

(2) Semi-Actuated Signal Control

The use of semi-actuated signal control provides for lower levels of green time being allocated to the sidestreet and, conversely, higher amounts of green to the main street than would occur under fixed time signal control. This, in turn, minimizes the number of stops and amount of vehicle delay to the main street and also to the intersection as a whole. Thus, energy consumption is reduced by use of a S.A. mode of control over that which would occur under fixed time signal control. Significant fuel savings can also be achieved by

enhancements to the existing semi-actuated controlled intersections.

(a) Conversion of Fixed Time to Semi-Actuated (S.A.) Control

Metro Roads and Traffic Department, through the Traffic Control Centre (T.C.C.) is currently engaged in an ongoing program of improving and expanding the system of intersections under signal control in Metro. As part of this program, the T.C.C. is now converting fixed time controllers to semi-actuated controllers at the rate of approximately 5 intersections per year. At this rate, it will take approximately 25 years before the 125 intersections to be modified in this manner are all converted.

(b) Enhancements to S.A. Control

The T.C.C. is also undertaking to enhance some 300 conventional semi-actuated (S.A.) controllers by installing semi-actuated presence loop detection (i.e., SAPLO control) and/or separating pedestrian call capability from vehicle call capability. Currently, approximately 35 conventional S.A. controllers are being enhanced per year, and at this rate, it will take aproximately 8.5 years before this program is completed.

(3) Variable Traffic Signal Phasing Throughout the Day

This measure deals with fuel savings which could be achieved by more efficiently utilizing signal phasing through the day by varying it to correspond to variations in traffic. The specific improvement areas addressed under this category, are discussed below.

(a) Conversion of Fixed Advanced Green to Demand Responsive Advanced Green

The Traffic Control Centre (T.C.C.) have identified some 335 potential locations where DRAG split-phase operation would be more effective than FAG operation. The T.C.C. are currently implementing only 6 such installations each year.

The measures recommended for immediate implementation and monitoring are outlined in Exhibit 1.3. Herein, the energy savings and costs associated with each measure are presented. Also presented are two implementation schedules; one being that which would occur assuming existing programs continued at the current rate and the other representing an accelerated program of 5 years.

(E) PROPOSED ACCELERATED IMPLEMENTATION PROGRAM

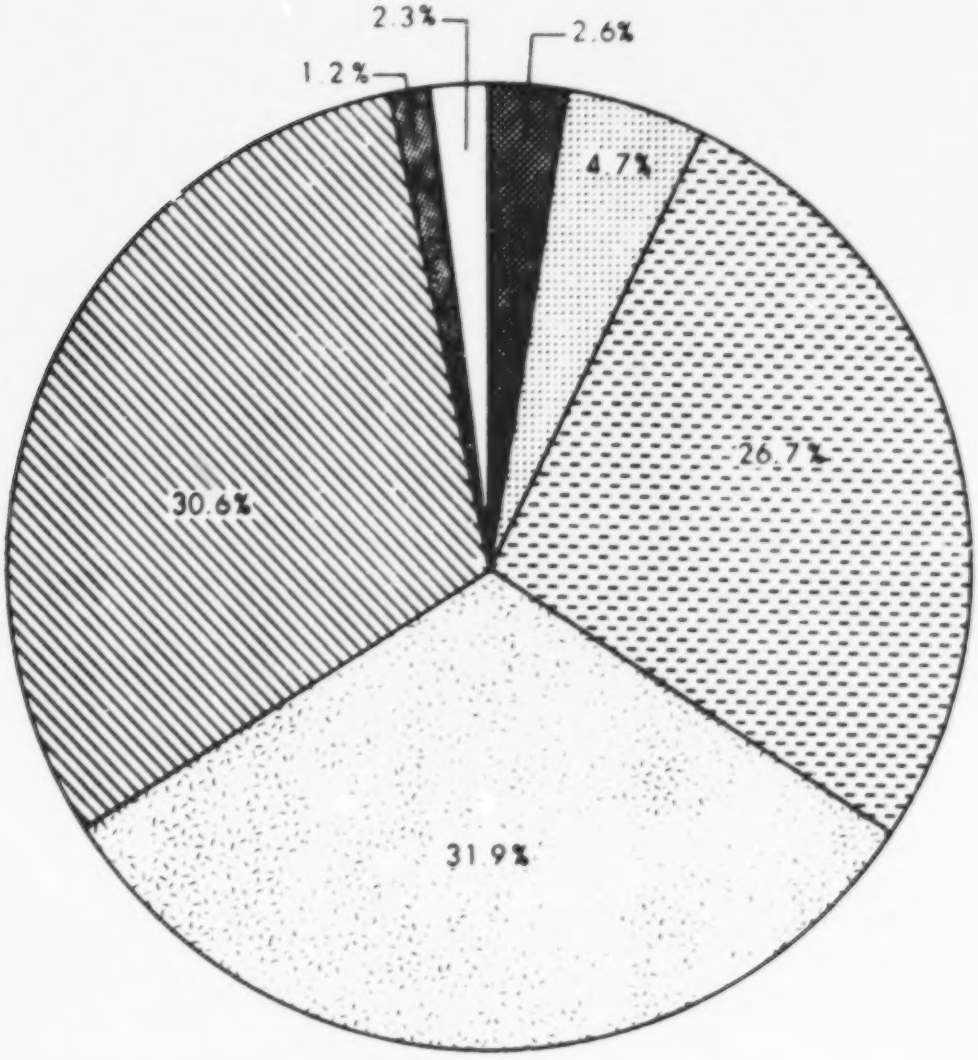
The primary purpose of an accelerated implementation schedule is to attain the full energy saving benefits of each measure as soon as possible. The accelerated program has implications in terms of expenditures and possibly staffing and modifications to existing Roads and Traffic programs as well. For example, in order to implement computer optimized signal timing in Metro within the next 4 years modifications to the current traffic counting program would have to take place or supplementary counts would have to be performed according to specifications from the Traffic Control Centre. Assuming that supplementary traffic counts were conducted at 50% of all signalized locations, the cost to Metro Roads and Traffic would be $145,000.00. This, however, would permit users of the arterial and collector road system in Metro to begin saving 42 million litres of gasoline at least 1 year earlier than would be the case under the existing program. The fuel savings to the general public for that year would be $18.9 million, assuming $0.45 per litre of gasoline.

The impact of advancing the existing program to convert fixed time to semi-actuated (S.A.) control from 25 years to 5 years would increase Metro's annual expenditures for the first 5 years from $50,000.00 to an average of $268,000.00. This, in turn, would have the effect of ensuring that the potential 18.8 million litres of gasoline to be saved annually (at a value of $8.5 million) would occur 20 years sooner.

In a similar manner, advancing the program of enhancements to existing semi-actuated control from 8.5 to 5 years would increase annual Metro expenditures from $70,000.00 to $135,000.00 for the initial 5 years. The 37.5 million litres of gasoline to be saved each year from this measure (representing $16.9 million annually) would be advanced by 3 years under the accelerated program.

The impact of advancing the implementation program of the conversion of fixed advanced green split-phasing to demand responsive advanced green split phasing from 56 years to 5 years would increase Metro Roads and Traffic annual expenditures from $7,200. to $95,000 for the first 5 years. Thereafter, there would be no further annual expenditures under the accelerated program. The benefits to be gained under the accelerated program would be to begin saving 4.7 million litres of gasoline annually at the end of year 5 instead of at the end of year 56. This represents a savings of $2.1 million per year.

EXHIBIT 1.1
ENERGY CONSUMPTION BY FACILITY AND TRAFFIC CONTROL DEVICE



PUBLIC TRANSIT ELECTRIC

PUBLIC TRANSIT DIESEL

LOCAL ROAD FREE FLOW

LOCAL ROAD STOP CONTROL

FREEWAY FREE FLOW

ARTERIAL / COLLECTOR FREE FLOW

ARTERIAL / COLLECTOR TRAFFIC SIGNAL CONTROL

M.T.A.T.E.S. – PHASE II

EXHIBIT 1-2
SUMMARY OF DETAILED ANALYSIS

MEASURE	Energy Savings: Total (Litres/yr)	Energy Savings: % Reduction (areawide)	Number of Applications	Cost: Per Application	Cost: Total	Implementation: Applications Per Year	Implementation: Total Years	Benefit/Cost Ratio (2)
Traffic Signal Timings:								
. Computer optimized timing (1)	42,000,000	1.5%	1450	$ 200	$ 145,000	600	2.5	1313
. Semi-actuated signal control (1)	55,300,000	2.0%	425	10,000 & 2000	1,350,000	5 & 35	25 & 8.5	135
. Variable phasing throughout the day	4,700,000	0.17%	335	1,200	402,000	6	56	53
. Traffic responsive control at critical intersections	N.App							
Turn Conflict Treatments								
. Provide left turn lane	360,000	0.01%	32	80,000	2,560,000	3	11	0.6
. Provide right turn lane	1,130,000	0.04%	31	80,000	6,480,000	2	41	0.8
. Increase Storage length	N.App							
. 2-way centre left turn lanes	Negligible	Negligible	1					
Additional Capacity								
. Widen Intersections	N.App							
. Provide bus bays	1,435,000	0.05%	79	80,000	6,320,000	2	82	1.0
Reduce Transit Travel Time								
. Reserved lanes for buses	20,000	Negligible	3 routes	N.App				
. Express bus service	1,040,000	0.03%	18 routes	5000/yr	90,000/yr	To be determined		5.2
Route & Schedule Improvements								
. Employ computerized scheduling tools	Not analyzed							
Promote Transit Use								
. Transit Marketing	Not Analyzed							
. Provide special services	Negligible	-	-	-	-	-	-	
Variable Work Hours								
.Variable Work Hours	1,200,000	0.04%	10,700 downtown employees	0	0	To be determined		
Fleet Management								
. Vehicle maintenance and reporting	510,000	0.02%	Municipal fleets	0	0	0	0	
. Driver training	1,275,000	0.05%	Municipal fleets	0	0	0	0	

(1) 2 measures were examined (a) conversion of F.T. to SA control and (b) enhancement of existing SA controllers. (2) Assuming $0.48/litre gasoline

EXHIBIT 1.3

MEASURES RECOMMENDED FOR IMMEDIATE IMPLEMENTATION AND MONITORING

Measure	Energy Savings Total (litres/yr.)	Energy Savings % Reduction (areawide)	Total Number of Applications	Cost* Per Application (Average)	Cost* Total	Applications Existing	Per Year Proposed	Implementation Total Years Existing	Implementation Total Years Proposed
Computer optimized timing	42,000,000	1.5%	1,450	$ 200	$ 145,000	0	300-400	3.5-4.5	4
Semi-actuated signal control									
· conversion of fixed time to semi-actuated control	18,800,000	0.64%	125	$11,000	$1,375,000	5	25	25	5
· enhancements to existing semi-actuated control	37,500,000	1.34%	300	$ 1,650	$ 495,000	35	75	8.5	5
Variable phasing throughout the day									
· conversion of fixed advanced green to demand responsive advanced green	4,700,000	0.17%	335	$ 1,300	$ 435,500	6	67	56	5

(1) Per supplementary traffic count location
(2) Assumes 50% of locations would be comprised of supplementary counts
(3) Expected to be approximately 720 per year once an updated set of counts have been collected by end of 1984